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Force transmission across a core-sheath interface in peripheral nerves [poster presentation]

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Text:

INTRODUCTION: As limbs move and nerves stretch and bend, the internal structures of peripheral nerves need to move in relation to each other. However, the way in which intraneural layers interact, move and respond to loading is poorly understood. These layers are disrupted during trauma, and regeneration of this internal movement is likely to form an important component of successful nerve repair and neural tissue engineering. It is therefore essential to understand in detail how the layers move in normal nerves.This group has described a novel, mechanically distinct layer, between an inner neural core and an outer sheath, which exists in the rat sciatic nerve. Scanning electron microscopy has suggested that radial connections may exist between the core and sheath. Current work has focused on identifying the mechanical characteristics of this layer and how core and sheath interact. Resistance to movement between core and sheath exists. If shear forces within a viscous fluid were responsible for this resistance they might be expected to reform after an initial primary pull, and exert resistance during a secondary pull. If physical connections were responsible for the resistance, they would break during an initial pull, and very little resistance would be present during a second pull. If both physical connections and shear forces within a viscous fluid produce resistance, a combination of these mechanical properties would be seen.

MATERIALS AND METHODS: Rat sciatic nerves were harvested and placed in a purpose built jig in such a way as to attach the proximal core to an upper clamp and distal sheath to a lower clamp. A tensile testing machine was used to pull inner core from outer sheath at a velocity of 10 mm/min. Control maximum pull-out force was established in 15 mm length nerves. Specimens, in which core had previously been pulled from sheath by 25% of initial length to achieve a 15 mm core-sheath overlap, were then tested. Maximum pull-out force during this second pull was recorded.

RESULTS: For a 15 mm length of nerve a mean maximum pull-out force of 0.41+/- 0.04 N (n=9) was required to pull core from sheath. In the samples in which core had already been partially pulled from sheath, the mean maximum pull-out force was 0.06 +/- 0.03 N (n=4). This mean value is approximately 7 times smaller than the control mean (p=0.0004).

CONCLUSIONS: A central neural core can be pulled from an outer connective tissue sheath of rat sciatic nerve and the maximum force required is consistent between different samples of nerve. When a 25% movement of core from sheath had previously occurred, the maximum pull-out force was significantly reduced during a second pull. The interactions between core and sheath are therefore predominantly due to physical interconnections, rather than shear forces within a viscous fluid.

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